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WHEEL TRAVEL TYPE HYDRAULIC CONSTRUCTION MACHINE
[HOIIRUSOKOSIKIYUATSU KENSETSUKIKAI]

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[What is Claimed is:]

[Claim 1]

A wheel travel type hydraulic construction machine comprised of:

a travel drive device, which is driven by an acceleration pedal;

a machine drive device, which is driven by an operation lever;

a rotational speed setting means, which sets the rotational speed of a motor by using a first rotational speed characteristic of the motor, which is suitable for traveling and determined based on the amount of operation of said acceleration pedal, a second rotational speed characteristic of the motor, which is suitable for a work operation and determined based on the amount of operation of said acceleration pedal, or a third rotational speed characteristic of the motor, which is suitable for a work operation and determined based on the amount of operation of the rotational speed adjusting member;

a rotational speed adjusting means, which adjusts the rotational speed of the motor to a value, which is set by

¹ Numbers in the margin display pagination in the foreign text.

said rotational speed setting means, in accordance with said amount of operation of the acceleration pedal or said amount of operation of the rotational speed adjusting member;

a mode setting means, which sets the high-horsepower driving mode, which makes a high-horsepower drive;

a load detecting means, which detects the traveling load of said travel drive device and the workload of said machine drive device; and

an rotational speed increasing means, which increases the rotational speed of the motor, that is set by said rotational speed setting means (based on said first

rotational speed characteristic of motor) [translator's note: this part should be added in consideration of the context and paragraph "[0006]". In the Japanese original, somehow this part of the text was omitted.], by a specified amount in the case wherein said high-horsepower driving mode is set during traveling and said traveling load, which is detected by said load detecting means, is a specified value or higher and said amount of operation of the acceleration pedal is a specified value or higher, and increases the rotational speed of the motor, that is set based on said third rotational speed characteristic of the motor, by a specified amount in the case wherein said high-

horsepower driving mode is set during a work operation and said workload, which is detected by said load detecting means, is a specified value or higher and said amount of operation of said rotational speed adjusting member is a specified value or higher, characterized in that, according to the second rotational speed characteristic of the motor, when said amount of operation of the acceleration pedal is a specified value or higher, the rotational speed of the motor is not lower than a value, which is obtained by increasing the rotational speed of the motor, which is set based on the third rotational speed characteristic of the motor during a work operation, by said rotational speed increasing means.

[Claim 2]

A wheel travel type hydraulic construction machine, characterized in that said wheel travel type hydraulic construction machine is comprised of:

a travel drive device, which is driven by an acceleration pedal;

a machine drive device, which is driven by an operation lever;

a rotational speed setting means, which sets the rotational speed of a motor by using a first rotational speed characteristic of the motor, which is suitable for

traveling and determined based on the amount of operation of said acceleration pedal, a second rotational speed characteristic of the motor, which is suitable for a work operation and determined based on the amount of operation of said acceleration pedal, or a third rotational speed characteristic of the motor, which is suitable for a work operation and determined based on the amount of operation of the rotational speed adjusting member;

a rotational speed adjusting means, which adjusts the rotational speed of the motor to a value, which is set by said rotational speed setting means, in accordance with said amount of operation of the acceleration pedal or said amount of operation of the rotational speed adjusting member;

a mode setting means, which sets the high-horsepower driving mode, which makes a high-horsepower drive;

a load detecting means, which detects the traveling load of said travel drive device and the workload of said machine drive device; and

an rotational speed increasing means, which increases the rotational speed of the motor, that is set by said rotational speed setting means based on the first rotational speed characteristic of the motor, by a specified amount in the case wherein said high-horsepower

driving mode is set during traveling and said traveling load, which is detected by said load detecting means, is a specified value or higher and said amount of operation of the acceleration pedal is a specified value or higher, and increases the rotational speed of the motor, that is set based on said second or third rotational speed characteristic of the motor, by a specified amount in the case wherein said high-horsepower driving mode is set during a work operation and said workload, which is detected by said load detecting means, is a specified value or higher and said amount of operation of said rotational speed adjusting member is a specified value or higher or said amount of operation of the acceleration pedal is a specified value or higher.

[Claim 3]

A wheel travel type hydraulic construction machine, characterized in that said wheel travel type hydraulic construction machine is comprised of:

a travel drive device, which is driven by an acceleration pedal;

a machine drive device, which is driven by an operation lever;

a rotational speed setting means, which sets the rotational speed of a motor by using a first rotational

speed characteristic of the motor, which is suitable for traveling and determined based on the amount of operation of said acceleration pedal, or a second rotational speed characteristic of the motor, which is suitable for a work operation and determined based on the amount of operation of said acceleration pedal;

a rotational speed adjusting means, which adjusts the rotational speed of the motor to a value, which is set by said rotational speed setting means, in accordance with said amount of operation of the acceleration pedal or said amount of operation of the rotational speed adjusting member;

a mode setting means, which sets the high-horsepower driving mode, which makes a high-horsepower drive;

a load detecting means, which detects the traveling load of said travel drive device and the workload of said machine drive device; and

an rotational speed increasing means, which increases the rotational speed of the motor, that is set based on said first or second rotational speed characteristic of the motor, by a specified amount in the case wherein said high-horsepower driving mode is set during traveling and said traveling load, which is detected by said load detecting means, is a specified value or higher and said amount of

operation of the acceleration pedal is a specified value or higher, or in the case wherein said high-horsepower driving mode is set during a work operation and said workload, which is detected by said load detecting means, is a specified value or higher and said amount of operation of the acceleration pedal is a specified value or higher.

[Claim 4]

The wheel travel type hydraulic construction machine, as set forth in one of claims 1 to 3, comprised of a traveling mode setting means, which sets the traveling mode, characterized in that, even when the high-horsepower driving mode is not set, if said traveling mode is set, said rotational speed increasing means controls said operation of increasing the rotational speed of the motor based on said amount of operation of the acceleration pedal and said traveling load.

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to the operation of controlling the rotational speed of a wheel travel type hydraulic construction machine such as a wheel type hydraulic loading shovel.

[0002]

[Prior Arts]

Conventionally, in the wheel type hydraulic loading shovel, the rotational speed of the motor is increased or decreased by an acceleration pedal so as to obtain desired traveling speed. In addition, during a work operation, the rotational speed of the motor can be increased or decreased in accordance with the amount of operation of the acceleration pedal. In the wheel type hydraulic loading shovel, the required horsepower during traveling is higher than the required horsepower during a work operation. Therefore, when the above described control of the rotational speed of the motor is to be done, two types of rotational speed characteristics of the motor, which are set based on the amount of operation of the acceleration pedal, are set so that the output horsepower during traveling is increased corresponding to the same stepping-on operation amount.

[0003]

Furthermore, in the above described wheel type hydraulic loading shovel, it is possible to set the high-horsepower travel driving mode, wherein the loading shovel is driven by high-horsepower to travel. When the high-horsepower travel driving mode is set, if the amount of operation of the acceleration pedal is a specified value or higher, for

example, the acceleration pedal is fully depressed, the rotational speed of the motor is increased by a specified amount. As a result, the output horsepower is increased.

[0004]

[Problem to be Solved by the Invention]

However, in the control device of the rotational speed of the motor of the above described conventional wheel type hydraulic loading shovel, the high-horsepower driving mode cannot be set during a work operation. Therefore, it is not possible to use the high output horsepower, which is used during traveling, for a work operation.

[0005]

The objective of the present invention is to provide a wheel travel type hydraulic construction machine, which can fully exert the performance of the motor even during a work operation so as to increase the excavation ability and workability.

[0006]

[Means to Solve the Problem]

Next, the present invention will be described by using the drawings of the embodiments of the present invention.

(1) The wheel travel type hydraulic construction machine, as set forth in claim 1, is comprised of: travel drive device 1, which is driven by acceleration pedal 22; machine

drive device 34, which is driven by operation lever 31; rotational speed setting means 50, which sets the rotational speed of a motor by using first rotational speed characteristic L1 of the motor, which is suitable for traveling and determined based on the amount of operation of acceleration pedal 22, second rotational speed characteristic L2 of the motor, which is suitable for a work operation and determined based on the amount of operation of acceleration pedal 22, or third rotational speed characteristic L3 of the motor, which is suitable for a work operation and determined based on the amount of operation of rotational speed adjusting member 55a; rotational speed adjusting means 53, which adjusts the rotational speed of the motor to a value, which is set by rotational speed setting means 50, in accordance with the amount of operation of acceleration pedal 22 or the amount of operation of rotational speed adjusting member 55a; mode setting means 56, which sets the high-horsepower driving mode, which makes a high-horsepower drive; load detecting means 42, which detects the traveling load of travel drive device 1 and the workload of machine drive device 34; and rotational speed increasing means 506, 508A and 508B, which increase the rotational speed (Ntmax) of the motor, that is set by rotational speed setting means 50 based on first

rotational speed characteristic L1 of the motor, by specified amount (ΔN) in the case wherein the high-horsepower driving mode is set during traveling and the traveling load, which is detected by load detecting means 42, is a specified value or higher and the amount of operation of acceleration pedal 22 is a specified value or higher, and increase the rotational speed (Ndlmax) of the motor, that is set by rotational speed setting means 50 based on third rotational speed characteristic L3 of the motor, by specified amount (ΔN) in the case wherein the high-horsepower driving mode is set during a work operation and the workload, which is detected by load detecting means 42, is a specified value or higher and the amount of operation of rotational speed adjusting member 55a is a specified value or higher, and characterized in that, according to second rotational speed characteristic L2 of the motor, when the amount of operation of acceleration pedal 22 is a specified value or higher, the rotational speed (Ndmax) of rotations of the motor is not lower than value (Ndlmax + ΔN), which is obtained by increasing the rotational speed (Ndlmax) of the motor, which is set based on third rotational speed characteristic L3 of the motor during a work operation, by rotational speed increasing

means 506, 508A and 508B. Figure 5 shows an example of the rotational speed characteristics according to claim 1.

(2) The wheel travel type hydraulic construction machine, as set forth in claim 2, is characterized in that said wheel travel type hydraulic construction machine is comprised of: travel drive device 1, which is driven by acceleration pedal 22; machine drive device 34, which is driven by operation lever 31; rotational speed setting means 50, which sets the rotational speed of a motor by using first rotational speed characteristic L1 of the motor, which is suitable for traveling and determined based on the amount of operation of acceleration pedal 22, second rotational speed characteristic L2 of the motor, which is suitable for a work operation and determined based on the amount of operation of acceleration pedal 22, or third rotational speed characteristic L3 of the motor, which is suitable for a work operation and determined based on the amount of operation of rotational speed adjusting member 55a; rotational speed adjusting means 53, which adjusts the rotational speed of the motor to a value, which is set by rotational speed setting means 50, in accordance with the amount of operation of acceleration pedal 22 or the amount of operation of rotational speed adjusting member 55a; mode setting means 56, which sets the high-horsepower driving

mode, which makes a high-horsepower drive; load detecting means 42, which detects the traveling load of travel drive device 1 and the workload of machine drive device 34; and rotational speed increasing means 506 and 508, which increase the rotational speed (N_{tmax}) of the motor, that is set by rotational speed setting means 50 based on first rotational speed characteristic L1 of the motor, by specified amount (ΔN) in the case wherein the high-horsepower driving mode is set during traveling and the traveling load, which is detected by load detecting means 42, is a specified value or higher and the amount of operation of acceleration pedal 22 is a specified value or higher, and increase the rotational speed (N_{dlmax} or N_{damax}) of the motor, that is set based on second rotational speed characteristic L2 or third rotational speed characteristic L3 of the motor, by specified amount (ΔN) in the case wherein the high-horsepower driving mode is set during a work operation and the workload, which is detected by load detecting means 42, is a specified value or higher and the amount of operation of rotational speed adjusting member 55a is a specified value or higher or the amount of operation of acceleration pedal 22 is a specified value or higher.

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Figure 8 shows an example of the rotational speed characteristics according to claim 2.

(3) The wheel travel type hydraulic construction machine, as set forth in claim 3, is characterized in that said wheel travel type hydraulic construction machine is comprised of: travel drive device 1, which is driven by acceleration pedal 22; machine drive device 34, which is driven by operation lever 31; rotational speed setting means 50, which sets the rotational speed of a motor by using first rotational speed characteristic L1 of the motor, which is suitable for traveling and determined based on the amount of operation of acceleration pedal 22 and second rotational speed characteristic L2 of the motor, which is suitable for a work operation and determined based on the amount of operation of acceleration pedal 22; rotational speed adjusting means 53, which adjusts the rotational speed of the motor to a value, which is set by rotational speed setting means 50, in accordance with the amount of operation of acceleration pedal 22 or the amount of operation of rotational speed adjusting member 55a; mode setting means 56, which sets the high-horsepower driving mode, which makes a high-horsepower drive; load detecting means 42, which detects the traveling load of travel drive device 1 and the workload of machine drive device 34; and

rotational speed increasing means 506 and 508, which increase the rotational speed (Ntmax or Ndamax) of the motor, that is set based on first rotational speed characteristic L1 or second rotational speed characteristic L2 of the motor, by specified amount (ΔN) in the case wherein the high-horsepower driving mode is set during traveling and the traveling load, which is detected by load detecting means 42, is a specified value or higher and the amount of operation of acceleration pedal 22 is a specified value or higher, or in the case wherein the high-horsepower driving mode is set during a work operation and the workload, which is detected by load detecting means 34, is a specified value or higher and the amount of operation of acceleration pedal 22 is a specified value or higher.

Figure 8 shows an example of the rotational speed characteristics according to claim 3.

(4) The wheel travel type hydraulic construction machine, as set forth in claim 4, is characterized in that the wheel travel type hydraulic construction machine, as set forth in one of claims 1 to 3, is comprised of traveling mode setting means 58, which sets the traveling mode, and, even when the high-horsepower driving mode is not set, if the traveling mode is set, rotational speed increasing means 50 controls the operation of increasing the rotational speed

of the motor based on the amount of operation of acceleration pedal 22 and the traveling load.

[0007]

Here, in the present section titled "Means to Solve the Problem", which describes the structure of the present invention, to clarify the present invention, the drawings of the embodiments of the present invention. However, the present invention is not limited to these embodiments.

[0008]

[Preferred Embodiments of the Invention]

(Embodiment 1)

An embodiment of the present invention, wherein the present invention is applied to a wheel type hydraulic loading shovel, will be described by using Figures 1 to 6. In the wheel type hydraulic loading shovel, a rotating body is rotatably mounted on a traveling body and a work attachment is mounted on said traveling body. The traveling body has a traveling variable hydraulic motor 1, which is driven in a traveling hydraulic circuit shown in Figure 1.

[0009]

As shown in Figure 1, the direction and flow rate of oil discharged from main pump 3, which is driven by engine 2, are controlled by control valve 4 and supplied to traveling motor 1 through brake valve 6, which has built-in counter-

balance valve 5. The output axis of traveling motor 1 is connected to transmission 7. The revolution of traveling motor 1 drives tires 10 through transmission 7, propeller shafts 8 and axles 9 so that the wheel type hydraulic loading shovel travels.

[0010]

The displacement volume (tilting angle) of main pump 3 is adjusted by regulator 11 in accordance with the discharge pressure of the pump. Regulator 11 has torque control part.

The pump discharge pressure is fed back to the torque control part and the so called horsepower control is done.

The horsepower control means the control of the displacement volume of the pump so that the load, which is determined based on the pump discharge pressure and the pump displacement volume, does not exceed the engine output.

In addition, regulator 11 has maximum tilt control part. By the maximum tilt control part, the maximum flow rate of main pump 3 is determined.

[0011]

The switching direction and stroke amount of control valve 4 are controlled by the pilot pressure from the pilot circuit. By adjusting the stroke amount, it is possible to control the traveling speed of the car. The pilot circuit is comprised of pilot pump 21, traveling pilot valve 23,

which generates pilot secondary pressure in accordance with the amount of operation of acceleration pedal 22, slow return valve 24, which comes after pilot valve 23 and delays return of oil to pilot valve 23 and forward and backward movement switching valve 25, which comes after slow return valve 24 and selects the forward, backward or neutral movement of the car. Forward and backward movement switching valve 25 is an electromagnetic switching valve, which is switched over by a forward and backward movement switch, which is described below.

[0012]

Figure 1 shows the state of the wheel type hydraulic loading shovel, wherein forward and backward movement switching valve 25 is in a neutral position (position N) and traveling pilot valve 23 is not operated. Therefore, control valve 4 is in a neutral position and pressured oil from main pump 3 returns to the tank and the car is stopped. When forward and backward movement switching valve 25 is switched to the forward movement position (position F) or backward movement position (position R) and acceleration pedal 22 is depressed, pilot secondary pressure, which corresponds to the amount of operation of acceleration pedal 22, is generated. The pilot pressure, which is generated in proportion to the operation of acceleration

pedal 22, passes through forward and backward movement switching valve 25, is outputted as the pilot pressured oil in the forward movement and the pilot pressured oil in the backward movement and works on the pilot port of control valve 4. Control valve 4 is switched by the stroke amount corresponding to the pilot pressure. By the switch over of control valve 4, the discharge oil from main pump 3 is fed to traveling motor 1 through control valve 4, center joint 12 and brake valve 6 and drives traveling motor 1. As a result, wheel type hydraulic loading shovel travels. The traveling pilot pressured oil is detected by pressure sensor 41 of Figure 1 and outputted as pressure signal P_t , which is described below.

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[0013]

Traveling motor 1 has a self-pressure tilting control mechanism. As the driving pressure is increased, traveling motor 1 increases the volume and drives at low speed and with a high torque. As the driving pressure is decreased, traveling motor 1 decreases the volume and drives at high speed and with a low torque. The driving pressure is exerted from shuttle valve 13 onto control piston 14 of traveling motor 1 and servo piston 15. The traveling

driving pressure is detected by pressure sensor 42 as pump pressure (P_p) and outputted.

[0014]

When acceleration pedal 22 is released during traveling, traveling pilot valve 23 shields the pressured oil from pilot pump 21 and the exit port is connected to the tank. As a result, the pressured oil, which works on the pilot port of control valve 4, returns to the tank through forward and backward movement switching valve 25, slow return valve 24 and traveling pilot valve 23. At this point, the returned oil is squeezed by the squeezing operation of slow return valve 24. Therefore, control valve 4 is gradually switched to the neutral position. When control valve 4 is switched to the neutral position, the discharge oil from main pump 3 returns to the tank, supply of the pressured oil (driving pressure) to traveling motor 1 is shielded and counter-balance valve 5 is also switched to the neutral position shown in the figure.

[0015]

In the above described case, the car body continues traveling by the inertial force of the car body, the operation of traveling motor 1 is changed from the motor operation to the pump operation and the side of port B becomes the suctioning side and the side of port A becomes

the discharge side. Since the pressured oil from traveling motor 1 is squeezed by the squeezing operation (neutral squeeze) of counter-balance valve 5, the pressure between counter-balance valve 5 and traveling motor 1 is increased and exerted on traveling motor 1 as the brake pressure. As a result, traveling motor 1 generates a brake torque and slows the pace of the car body. When the amount of the suctioned oil is insufficient during the pump operation, oil is supplied from make-up port 16 to traveling motor 1. The maximum brake pressure is controlled by relief valves 17 and 18.

[0016]

Since the returned oil of relief valves 17 and 18 is guided to the suctioning side of traveling motor 1, the circuit is closed within the motor during the relief operation and the temperature of operational oil is increased, which may negatively affect the devices. Therefore, a small amount of the pressured oil escapes from the neutral squeeze of counter-balance valve 5 and guided to control valve 4. In control valve 4, port A is connected to port B (A-B connection) and a circulating circuit, which returns the oil to the suctioning side of traveling motor 1, is created and the temperature of the operational oil is cooled.

[0017]

In the case wherein acceleration pedal 22 is released while the loading shovel is traveling downhill, as in the case wherein the speed is decreased, the oil-pressured brake is generated and the loading shovel goes downhill by the inertial force while the pace of the car continues to slow down. During travel downhill, even in the case wherein acceleration pedal 22 is depressed, counter-balance valve is activated and generates oil-pressured brake pressure so as to produce the motor rotating speed (traveling speed), which corresponds to the amount of oil flow from main pump 3 to traveling motor 1.

[0018]

The work attachment of the wheel type hydraulic loading shovel is comprised of, for example, a boom, an arm and a bucket. The driver's cabin has pilot operation levers for the arm, boom and bucket respectively. Figure 2 shows the boom oil pressure circuit as the representative example of the work attachment oil pressure circuit. When boom operation lever 31 is operated, oil-pressured pilot switch-type boom control valve 33 is switched by pressure, which is reduced by pressure reducing valve (pilot valve) 32 in accordance with the operation amount of boom operation level 31, the discharge oil from main pump 3 is guided to boom cylinder 34 through control valve 33 and the boom

moves up and down by the expansion and contraction of boom cylinder 34. When boom operation lever 31 is operated so as to lift the boom side, the boom lifting pilot pressured oil is supplied to the bottom of boom cylinder 34. When boom operation lever 31 is operated so as to lower the boom, the boom lowering pilot pressured oil is supplied to the rod side of boom cylinder 34.

[0019]

Although not shown in Figures 1 and 2, in addition to boom lever 31 and acceleration pedal 22, the loading shovel has an arm lever, a bucket lever and a rotating lever. The loading shovel is further comprised of a pressure reducing valve (pilot valve), which discharges pilot pressured oil in accordance with the operation amount of each lever in a manner similar to boom lever 31, a control valve, which is switched respectively by the discharge pilot pressured oil, and an actuator, which is driven by the pressured oil from the control valve.

[0020]

Figure 3 is a block diagram of the control circuit, which controls the rotational speed of the engine and the tilting amount of the pump. In Figure 3, each device is controlled by controller 50, which is comprised of a CPU and the like. Governor 51 of engine (motor) 2 is connected to pulse motor

53 through link mechanism 52 and the rotational speed of engine 2 is controlled by the rotation of pulse motor 53. In other words, the normal rotation of pulse motor 53 increases the rotational speed of engine 2. The reverse rotation of pulse motor 53 decreases the rotational speed of engine 2. The rotation of pulse motor 53 is controlled by a control signal from controller 50. Governor 51 is connected to potentiometer 54 through link mechanism 52. Potentiometer 54 detects the governor lever angle, which corresponds to the rotational speed of engine 2. The governor lever angle is inputted as engine control rotational speed ($N\theta$) in controller 50. Controller 50 is connected to: potentiometer 55, which issues target rotational speed (FL), which corresponds to the manual operation of fuel lever 55a installed in the driver's cabin; switch 56, which issues the high-horsepower driving mode; forward and backward movement switch 57, which orders switching of forward and backward movement valve 25 to position N, F or R; and brake switch 58.

[0021]

Brake switch 58 is switched to the traveling position, working position or parking position so as to output a working/traveling signal. When switch 58 is switched to the traveling position, it releases the parking brake and

allows the service brake to operate by the brake pedal. When brake switch 58 is switched to the working position, it operates the parking brake and the service brake. When brake switch 58 is switched to the parking position, it operates the parking brake.

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[0022]

In Figure 3, controller 50 is connected to pressure sensor 41, which detects traveling pilot pressure (P_t), and pressure sensor 42, which detects pump pressure (P_p). Pilot pressure (P_t) and pump pressure (P_p), which are detected by each of the above described sensors, are inputted in controller 50.

[0023]

Figure 4 is a conceptual diagram illustrating the detail of the controller 50. Function generator 501 outputs the target rotational speed (N_t) of the engine for traveling, which is proportional to the amount of operation of the acceleration pedal. Function generator 502 outputs the target rotational speed (N_{da}) of the engine for a work operation, which is proportional to the amount of operation of the acceleration pedal. Function generator 503 outputs the target rotational speed (N_{dl}) of the engine, which is proportional to the amount of operation of fuel lever 55a.

[0024]

In other words, function generators 501 and 502 respectively output the target rotational speed (N_t) for traveling and the target rotational speed (N_{da}) for a work operation (acceleration). The target rotational speed (N_t) and (N_{da}) are determined by functions (rotational speed characteristics) L1 and L2, which associate pilot pressure (P_t) detected by traveling pilot pressure sensor 41 with the target rotational speed of engine 2. Function generator 503 outputs the target rotational speed (N_{dl}) for a work operation (lever). The target rotational speed (N_{dl}) is determined by function (rotational speed characteristic) L3, which associates the signal produced based on the amount of operation of fuel lever 55a with the target rotational speed of engine 2.

[0025]

The output (N_t) of function generator 501 is added to the increased amount (ΔN) of the rotational speed, which is described below, in summing point 508A and inputted in selection switch 504. The output of function generator 502 is directly inputted in selection switch 504. Selection switch 504 is switched by a working/traveling signal, which is outputted by brake switch 58. In other words, selection switch 504 selects characteristic L1 when brake switch 58

is switched to the traveling position and it selects characteristic L2 when brake switch 58 is switched to the working position. The target rotational speed (N_{dl}) of the engine, which is proportional to the amount of operation of fuel lever 55a outputted from function generator 503, is added to increased amount (ΔN) of the rotational speed, which is described below, in summing point 508B and inputted in maximum value selecting circuit 505. Maximum value selecting circuit 505 selects the greater value between the target rotational speed of the engine, which is selected by selection switch 504, and the target rotational speed of the engine, which is outputted from summing point 508B, as the target rotational speed (N_y) of the engine.

[0026]

Next, characteristics L1 to L3 will be described in detail by referring to Figure 5. Characteristic L1 is a rotational speed characteristic for traveling, which is suitable for traveling dependent on the amount of operation of acceleration pedal 22. Characteristic L2 is a target rotational speed characteristic for a work operation, which is suitable for a work operation dependent on the amount of operation of acceleration pedal 22. The work operation means the excavation operation, which uses the work attachment. The start-up, that is, the slope of the target

rotational speed characteristic L1 is more precipitous than that of characteristic L2. The idling rotational speed (N_{tid}) and the maximum rotational speed (N_{tmax}) of characteristic L1 are set greater than the idling rotational speed (N_{did}) and the maximum rotational speed (N_{damax}) of characteristic L2, respectively. Characteristic L3 is a rotational speed characteristic for a work operation, which is suitable for a work operation dependent on the amount of operation of fuel lever 55a. The slope of rotational speed characteristic L3 is more gradual than that of characteristic L2, which is dependent on acceleration pedal 22. The idling rotational speed of characteristic L3 is the same as the idling rotational speed (N_{did}) of characteristic L2. However, the maximum rotational speed (N_{dlmax}) of characteristic L3 is set slightly lower than the maximum rotational speed (N_{damax}) of characteristic L2. In the case wherein the condition of the high-horsepower driving mode, which is described below, is achieved, when fuel lever 55a is fully pulled so as to issue the maximum rotational speed (N_{dlmax}), the rotational speed is increased by amount (ΔN) and the maximum rotational speed of characteristic L2 becomes N_{damax} (= $N_{dlmax} + \Delta N$).

[0027]

In Figure 4, discharge pressure (P_p) of oil pressure pump 3, which is the output of pressure sensor 42, is inputted in rotational speed correction value calculating part 506. In the case wherein the pump pressure is increased beyond rotational speed increasing pressure (P_{p1}), the rotational speed correction value (ΔN), which corresponds to the pump pressure, is outputted in accordance with the rotational speed increasing characteristic shown in the figure. The above described rotational speed correction value (ΔN) is outputted to summing points 508A and 508B when switch 507, which operates simultaneously with high-horsepower driving mode switch 56, is closed. When high-horsepower driving mode switch 56 is turned on by the operator and the stepping-in operation amount of acceleration pedal 22 is a specified value or higher, for example, acceleration pedal 22 is fully depressed, a high level signal is outputted from function generator 510 and switch 511 is closed. Consequently, a high level signal is outputted from switch 511 and switch 507 is closed. Alternately, when high-horsepower driving mode switch 56 is turned on by the amount of operation of operator and fuel lever 55a is a specified value or higher, for example, fuel lever 55a is fully pulled, a high level signal is outputted from function generator 510 and switch 511 is closed.

Consequently, a high level signal is outputted from switch 511 and switch 507 is closed.

[0028]

As shown in Figure 4, the target rotational speed issuing value (N_y), which is selected in maximum value selecting circuit 505, is compared with the control rotational speed (N_θ) corresponding to the amount of displacement of the governor lever, which is detected by potentiometer 54 in servo-control part 509. Then, in accordance with the procedure shown in Figure 6, pulse motor 53 is controlled so that the target rotational speed issuing value (N_y) matches the control rotational speed (N_θ).

[0029]

In step S21 of Figure 6, the target rotational speed issuing value (N_y) and the control rotational speed (N_θ) are read. Then, step S21 is followed by step S22. In step S22, the difference ($N_\theta - N_y$) is stored in the memory as difference (A) of the rotational speeds. In step S23, by using the preliminarily determined standard difference (K) of the rotational speeds, whether $|A| \geq K$ or not is judged. If it is judged that $|A| \geq K$ is the case, step S23 is followed by step S24, wherein whether or not the difference (A) of the rotational speeds is $A > 0$ is judged. If $A > 0$ is the case, the control rotational speed (N_θ) is greater

than the target rotational speed issuing value (N_y), that is, the control rotational speed is greater than the target rotational speed. Therefore, step S24 is followed by step S25. In step S25, a signal issuing the reverse rotation of the motor is outputted to pulse motor 53 so as to decrease the rotational speed of the engine. As a result, the rotation of pulse motor 53 is reversed thereby decreasing the rotational speed of engine 2.

[0030]

On the other hand, if it is judged that $A \leq 0$, the control rotational speed (N_θ) is smaller than the target rotational speed issuing value (N_y), that is, the control rotational speed is smaller than the target rotational speed.

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Therefore, step S24 is followed by step S26. In step S26, a signal issuing the normal rotation of the motor is outputted to pulse motor 53 so as to increase the rotational speed of the engine. As a result, the rotation of pulse motor 53 is normal thereby increasing the rotational speed of engine 2. If it is judged that $|A| \geq K$ is not the case in step S23, step S23 is followed by step S27. In step S27, a motor stopping signal is outputted. As a result, the rotational speed of engine 2 is maintained at

a constant value. When steps S25 to 27 are completed, the operation returns to the start point.

[0031]

Next, the operation of the control device of the rotational speed of the motor with the above described structure will be described more in detail. In Figure 4, during traveling, selection switch 504 selects the target rotational speed (N_t), which is set by characteristic L1 of the target rotational speed, by using brake switch 58. Since fuel lever 55a is fixed to the minimum operation position during traveling, the target rotational speed (N_y), which is outputted from summing point 508A, is the target rotational speed (N_t) of characteristic L1 + increased amount (ΔN) of the rotational speed. When the high-horsepower driving mode 56 is turned off, when the high-horsepower driving mode 56 is turned on but acceleration pedal 22 is not fully depressed, or when the pump pressure (P_p) is lower than a specified value (P_{p1}), $\Delta N = 0$ and the target rotational speed (N_y) = N_t .

[0032]

When high-horsepower driving mode 56 is turned on and acceleration pedal 22 is full depressed, if the discharge pressure (P_p) of oil pressured pump 3, which is detected by pressure sensor 42, exceeds a specified value (P_{p1}) (see

Figure 3), the rotational speed correction value (ΔN) is outputted from function generator 506.

[0033]

Therefore, when the high-horsepower driving mode is set, if acceleration pedal 22 is fully depressed and the load pressure (P_p) is a specified value (P_{p1}) or higher, the target rotational speed issuing value (N_y) is higher than the target rotational speed (N_t) by ΔN and the rotational speed of engine 2 is increased accordingly and the discharge flow rate of oil pressure pump 3 is increased.

[0034]

The next section will describe the case wherein fuel lever 55a is set in the minimum operation position during a work operation so that the rotational speed of the engine is adjusted by acceleration pedal 22. In other words, the next section will describe the case wherein a work operation is accelerated. During a work operation, selection switch 504 selects the target rotational speed (N_{da}), which is set by characteristic L2 of the target rotational speed, by using brake switch 58. Since fuel lever 55a is set in the minimum operation position, the target rotational speed (N_y), which is selected and outputted by maximum value selecting circuit 505, is the target rotational speed (N_{da}) of characteristic L2. At the time of accelerating the work

operation, as described in the diagram of the rotational speed characteristics of Figure 5, the target rotational speed is set higher than that of characteristic L3. Therefore, the target rotational speed (N_y) is set high regardless of on or off of high-horsepower driving mode switch 56. As a result, even at the time of accelerating the work operation, by fully depressing the acceleration pedal, the high-horsepower driving can be done with the same engine output as that of the high-horsepower driving by fuel lever 55a.

[0035]

The next section will describe the case wherein the rotational speed of the engine is adjusted by fuel lever 55a during a work operation. During a work operation, selection switch 504 selects the target rotational speed (N_{dl}), which is set by target rotational speed characteristic L2, by using brake switch 58. Function generator 503 outputs the target rotational speed (N_{dl}), which corresponds to the amount of operation of fuel lever 55a. The target rotational speed (N_{dl}), which is outputted from selection switch 504, is the idling rotational speed (N_{did}) unless acceleration pedal 22 is depressed. The target rotational speed (N_y), which is outputted from maximum value selecting circuit 505, is the target

rotational speed (N_{dl}) of characteristic L3 and increased amount (ΔN) of the rotational speed. When the high-horsepower driving mode 56 is turned off, $\Delta N = 0$ and $N_y = N_t$. In the meantime, when the high-horsepower driving mode 56 is turned on and acceleration pedal 22 is fully depressed, $N_y = N_{dl} + \Delta N$.

[0036]

As described above, according to Embodiment 1, as shown by characteristics L1 and L2 in Figure 5, the slope of target rotational speed characteristic L2 at the time of accelerating a work operation, that is, the changed amount (increasing and decreasing amount) of the rotational speed of the engine relative to the amount of operation, is made larger than the tilting angle of target rotational speed characteristic L3. In addition, the target rotational speed (N_{dmax}), which is set by fully depressing the acceleration pedal in characteristic L2, is set equal to the target rotational speed ($N_{dlmax} + \Delta N$), which is obtained by increasing the target rotational speed of characteristic L3 when working with heavy load by fully pulling the fuel lever. As a result, the following effects are obtained:

[0037]

(1) As is obvious from the graph of Figure 5, when the high-horsepower driving mode is turned on during a work

operation and fuel lever 55a is fully pulled, if the pump pressure (P_p) is a specified value or higher, the rotational speed of the engine is increased by ΔN . Therefore, it is possible to effectively use the engine. As described above, the wheel type hydraulic loading shovel requires higher horsepower during traveling than during excavation operation. Considering the fuel consumption and noise emission, the maximum rotational speed of the engine during excavation operation is set lower than that of the engine during traveling. Therefore, only when the high-horsepower driving operation is necessary, the output horsepower of the engine is effectively used.

(2) When the rotational speed of the engine is adjusted by acceleration pedal 22 during a work operation, by fully depressing acceleration pedal 22 without setting the high-horsepower driving mode, the target rotational speed is set equal to the target rotational speed ($N_{dlmax} + \Delta N$) during a work operation, which is obtained by fully pulling fuel lever 55a during the high-horsepower driving mode and increasing the rotational speed of the engine. As a result, it is possible to effectively use the engine horsepower during a work operation without selecting the high-horsepower driving mode.

[0038]

(3) If the operator prefers to adjust the rotational speed of the engine by using fuel lever 55a during a work operation and turning on the high-horsepower driving mode, even when he/she does not fully pull fuel lever 55a, he/she can achieve the high-horsepower driving only by fully depressing acceleration pedal 22. In this case, even when the operator forgets to turn on the high-horsepower driving mode, he/she can achieve the high-horsepower driving only by fully depressing acceleration pedal 22.

(4) If the operator prefers to adjust the rotational speed of the engine by using acceleration pedal 22 during a work operation, he/she can achieve the high-horsepower driving when working with heavy load only by fully depressing acceleration pedal 22 without paying attention to whether the high-horsepower driving mode is on or off. (5) When the rotational speed of the engine is increased to make an adjustment, the load and the type of actuator and its operational direction are taken into account.

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As a result, the workability of the loading shovel is increased, the noise emission is decreased and the fuel efficiency is improved.

[0039]

(Embodiment 2)

Figures 7 and 8 are schematic diagrams illustrating Embodiment 2 of the present invention. According to Embodiment 2, as shown in Figure 7, the slopes of characteristics L2 and L3 are made equal. That is, the changed amount of the rotational speed of the engine of characteristic L2 relative to the amount of operation is made equal to that of characteristic L3. At the same time, the idling rotational speed and the target rotational speed of the engine relative to the full operation of characteristics L2 and L3 are made equal. Only when the high-horsepower driving mode is set at the time of accelerating a work operation, the pressure of the load is a specified value or higher and acceleration pedal 22 is fully depressed, the rotational speed of the engine is increased by ΔN .

[0040]

In order to adopt the above described algorithm, according to Embodiment 2, a control block shown in Figure 8 is used. In Figure 8, the same codes as those of Figure 4 are used to indicate the same parts as those of Figure 4. Here, the different points are mainly described. Selection switch 504, which is switched by brake switch 58, selects the target rotational speed (N_t) of target rotational speed characteristic L1 for acceleration of traveling, which is

outputted from function generator 501, and the target rotational speed (N_{da}) of target rotational speed characteristic L2 for acceleration of a work operation, which is outputted from function generator 502. The target rotational speed, which is selected by selection switch 504, is inputted in maximum value selecting circuit 507 and compared with the target rotational speed (N_{dl}) of characteristic L3 for the fuel lever, which is outputted from function generator 503. At summing point 508, increased amount (ΔN) of the rotational speed, which is outputted in the above described high-horsepower driving mode, is added to the target rotational speed, which is outputted from maximum value selecting circuit 507. The obtained value is inputted as the target rotational speed (N_y) into servo-control part 509.

[0041]

As is obvious from the graph of Figure 7, when the high-horsepower driving mode is turned on and fuel lever 55a is fully pulled during a work operation, if the pump pressure (P_p) is specified value (P_{p1}) or higher, the rotational speed is increased by ΔN . Therefore, it is possible to effectively use the output horsepower of engine 2. In addition, even when the rotational speed of the engine is adjusted by acceleration pedal 22 during a work operation,

the rotational speed of the engine is increased in a manner similar to above. Therefore, it is possible to effectively use the engine horsepower.

[0042]

According to Embodiment 2, both in the case of adjustment of the rotational speed of the engine by acceleration pedal 22 (acceleration of a work operation), or the case of adjustment of the rotational speed of the engine by fuel lever 55a, when the high-horsepower driving mode is turned on, if a specified condition is achieved, the rotational speed of the engine is set to increase. Here, in the case wherein the high-horsepower driving mode is turned on, the rotational speed of the engine may be increased only at the time of accelerating the work operation. Adversely, the rotational speed of the engine may be increased only at the time of adjusting the rotational speed by the fuel lever.

[0043]

Here, the control circuit of Figure 4 may be that of Figure 9. In other words, switch 601, which is switched by a traveling signal, and high level signal output circuit 602 may be created between high-horsepower driving mode switch 56 and switch 511. Similarly, the control circuit of Figure 8 may be that of Figure 10. In other words, switch 601A, which is switched by a traveling signal, and high level

signal output circuit 602A may be created between high-horsepower driving mode switch 56 and AND gate 512. According to these control circuits, switch 601 or 601A is switched to high level signal output circuit 602 or 602A by a traveling signal. As a result, even if the operator forgets the operation of high-horsepower driving mode switch 56 during traveling, he/she can control increase of the rotational speed of the engine in the manner similar to the high-horsepower driving mode.

[0044]

Here, according to the above described embodiments, the rotational speed of the engine is set in accordance with the stepping-in operation amount of the acceleration pedal or the operation amount of the fuel lever. However, the present invention can be applied to the embodiment wherein the rotational speed of the engine is set by an up and down switch. In addition, according to the above described embodiments, as shown in Figure 5 or 7, the maximum target rotational speed is set when acceleration pedal 22 or fuel lever 55a is fully operated. However, according to the present invention, it is possible to set the maximum target rotational speed in a position of the operation amount, which is slightly before the full operation. Furthermore, in addition to the hydraulic loading shovel, the present

invention can be applied to other hydraulic construction machines in a manner similar to above.

[0045]

According to the above described embodiments, traveling motor 1 and the like constitute the travel drive device. Boom cylinder 54 and the like constitute the machine drive device. Pulse motor 53 and the like constitute the rotational speed adjusting means. Function generators 501 to 503 and the like constitute the rotational speed setting means. High-horsepower driving mode switch 56 constitutes the mode setting means. Fuel lever 55a constitutes the rotational speed adjusting member. Pressure switch 42 constitutes the load detecting means. Rotational speed correction value calculating part 506 constitutes the rotational speed increasing means. In addition, brake switch 58 is the traveling mode setting means and the traveling signal, which is outputted from brake switch 58, is the traveling mode signal.

[0046]

[Effects of the Invention]

As described above, in the wheel travel type hydraulic construction machine, according to the present invention, it is possible to achieve high-horsepower driving both during traveling and a work operation. In addition, it is

possible to effectively use the high output of the motor, which is set for traveling, for a work operation. Therefore, the present invention can provide a high performance construction machine. Especially, according to the invention as set forth in claim 1, in the case wherein the rotational speed of the motor is adjusted by the acceleration pedal during a work operation, when the stepping-in operation amount of the acceleration pedal is a specified value or higher, the target rotational speed of the motor is set not lower than the target rotational speed, which is set by the high-horsepower driving mode in the case wherein the rotational speed of the motor is adjusted by the rotational speed adjusting member. Therefore, it is possible to achieve high-horsepower driving only by increasing the amount of operation of the acceleration pedal by a specified value or higher without setting the high-horsepower driving mode. In addition, according to the invention as set forth in claim 4, even if the operator forgets to set the high-horsepower driving mode, by setting the traveling mode, he/she can control the increase of the rotational speed of the motor.

[Brief Description of the Drawings]

[Figure 1]

Figure 1 is a diagram of the oil pressure circuit of the wheel type loading shovel according to Embodiment 1.

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[Figure 2]

Figure 2 is a diagram illustrating the boom circuit of the machine oil pressure circuit.

[Figure 3]

Figure 3 is a diagram illustrating the control circuit.

[Figure 4]

Figure 4 is a diagram illustrating the detail of the controller of Figure 3.

[Figure 5]

Figure 5 is a graph illustrating the rotational speed characteristics of the engine.

[Figure 6]

Figure 6 is a flowchart illustrating the procedure of controlling the rotational speed of the engine.

[Figure 7]

Figure 7 is a graph illustrating the rotational speed characteristics of the engine according to Embodiment 2.

[Figure 8]

Figure 8 is a block diagram illustrating the detail of another embodiment of the rotational speed correction value calculation part.

[Figure 9]

Figure 9 is a diagram illustrating the detail of another embodiment of the controller of Figure 4.

[Figure 10]

Figure 10 is a diagram illustrating the detail of another embodiment of the controller of Figure 8.

[Explanation of the Codes]

1: oil-pressured motor for traveling

2: engine

3: displacement volume oil pressure pump

4: control valve

22: acceleration pedal

31: boom operation lever

33: boom control valve

34: boom cylinder

41 and 42: pressure sensor

50: controller

53: pulse motor

55: potentiometer

55a: fuel lever

56: high-horsepower driving mode selection switch

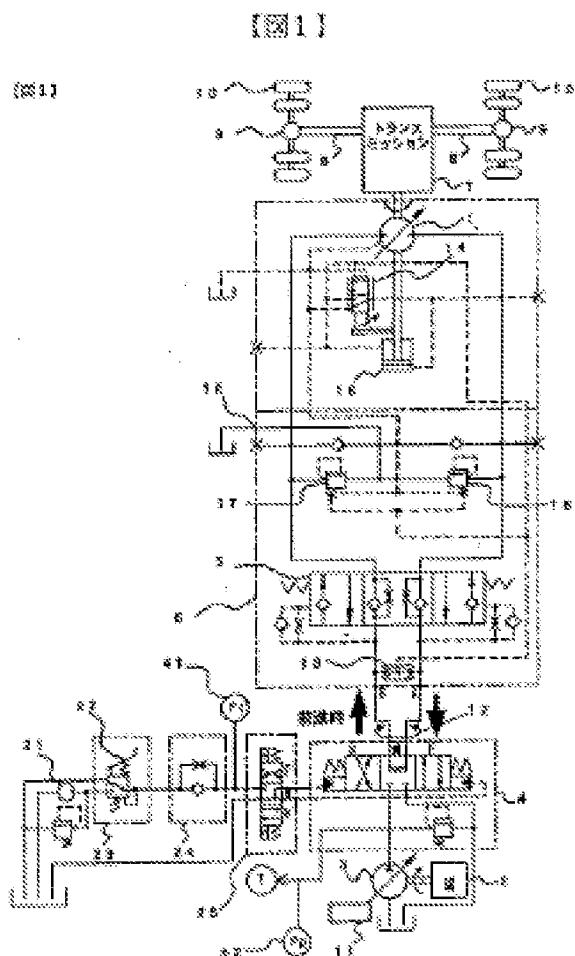
58: brake switch

501 to 503: function generator

509: servo-control part

508, 508A and 508B: adder

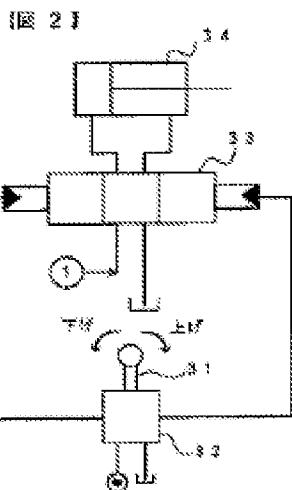
[Figure 1]



7: transmission

↑ during the forward movement

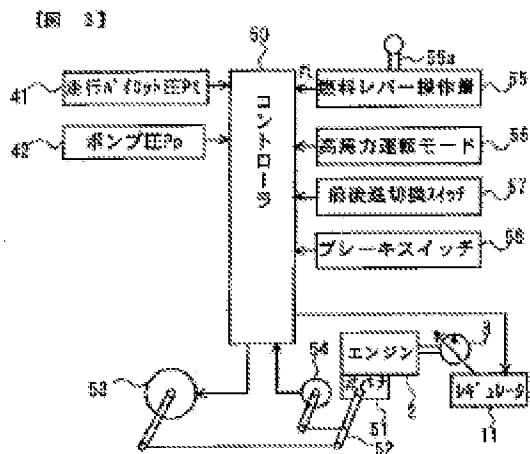
[Figure 2]



down (left arrow)

up (right arrow)

[Figure 3]



41: traveling pilot pressure (Pt)

42: pump pressure (Pp)

50: controller

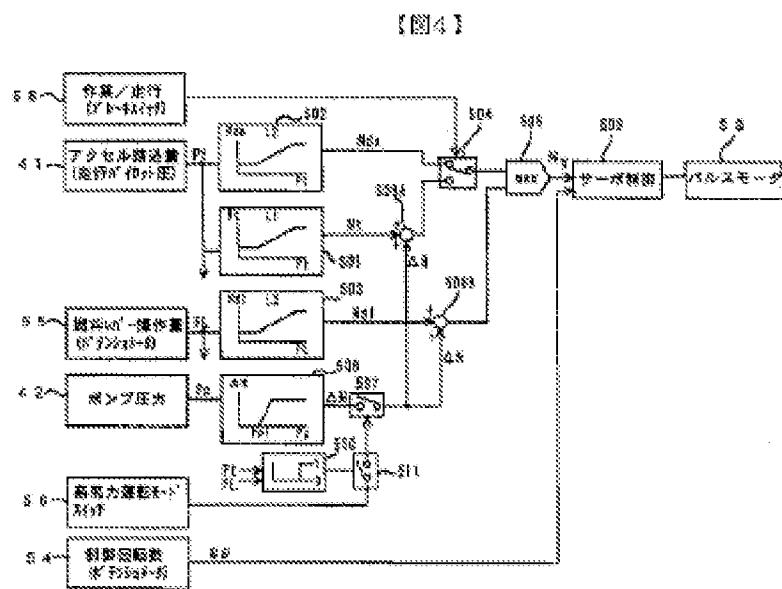
55: amount of operation of the fuel lever

56: high-horsepower driving mode

57: forward and backward movement switch
 58: brake switch
 2: engine
 11: regulator
 51: governor

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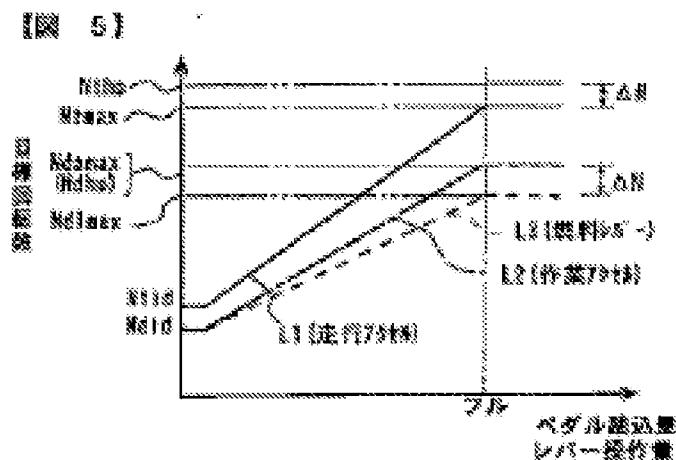
[Figure 4]



58: work/travel (brake switch)
 41: amount of operation of the acceleration pedal
 (traveling pilot pressure)
 55: amount of operation of the fuel lever (potentiometer)
 42: pump pressure
 56: high-horsepower driving mode switch
 54: controlled rotational speed (potentiometer)
 509: servo control

53: pulse motor

[Figure 5]



(x-coordinate) Target rotational speed

(y-coordinate) Stepping-in operation amount of the acceleration pedal, amount of operation of the lever

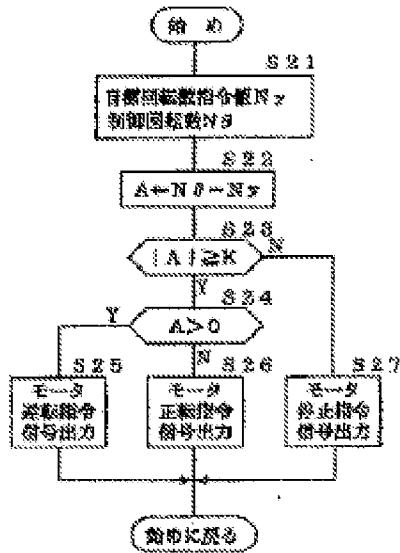
L3: (fuel lever)

L2: (acceleration of a work operation)

L1: (acceleration of traveling)

[Figure 6]

図 6)



(from top to bottom)

Start

S21: target rotational speed issuing value (Ny), controlled rotational speed (Nθ)

S25: A signal, which issues the reverse rotation of the motor, is outputted.

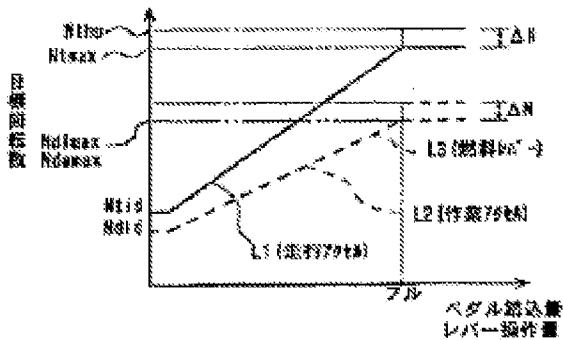
S26: A signal, which issues the normal rotation of the motor, is outputted.

S27: A signal, which issues stopping of the motor.

Return to Start

[Figure 7]

[Figure 7]



(x-coordinate) Target rotational speed

(y-coordinate) Amount of operation of the acceleration
pedal, amount of operation of the lever

L3: (fuel lever)

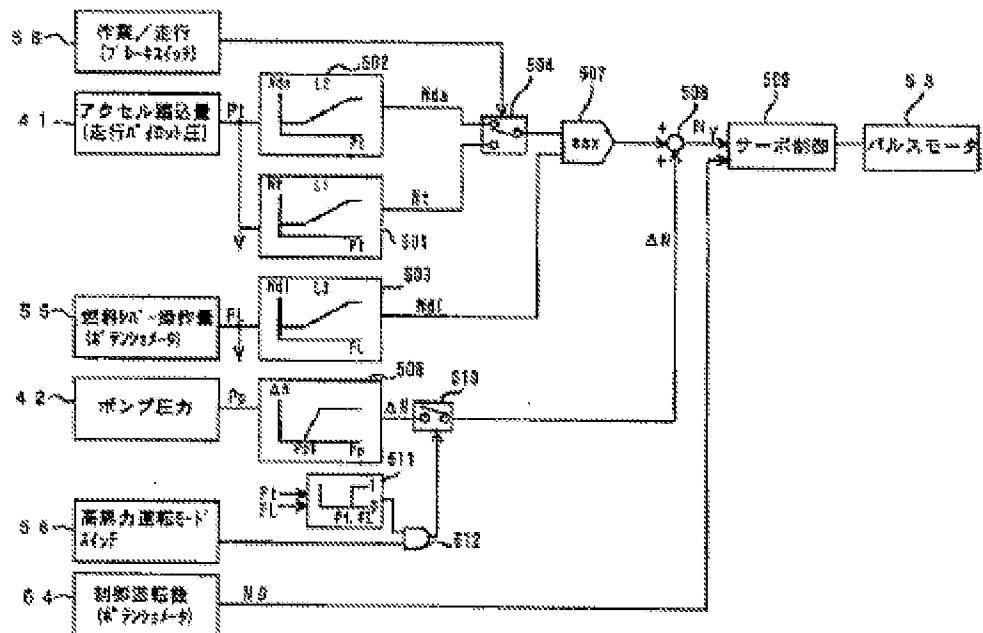
L2: (acceleration of a work operation)

L1: (acceleration of traveling)

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[Figure 8]

[図8]



58: work/travel (brake switch)

41: amount of operation of the acceleration pedal

(traveling pilot pressure)

55: amount of operation of the fuel lever (potentiometer)

42: pump pressure

56: high-horsepower driving mode switch

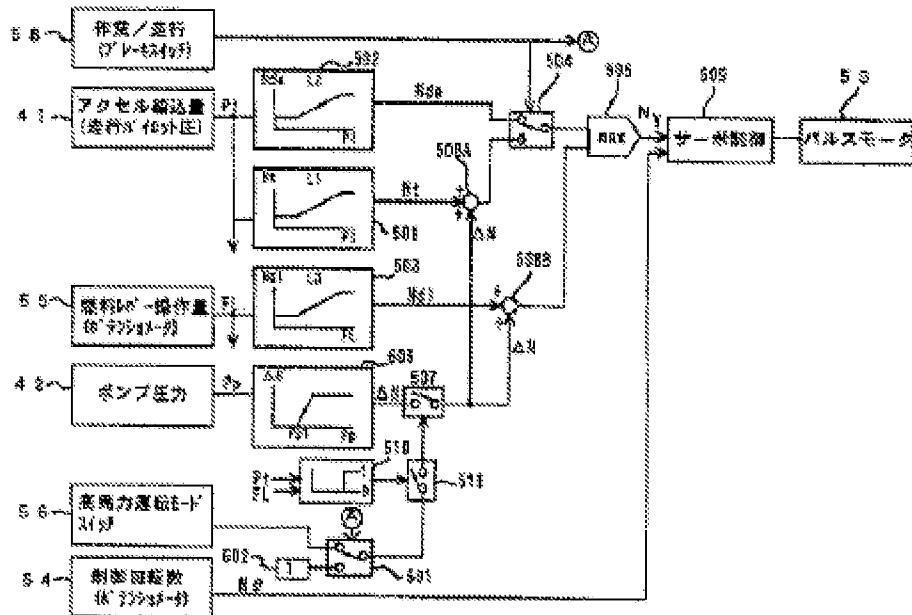
54: controlled rotational speed (potentiometer)

509: servo control

53: pulse motor

[Figure 9]

【図9】



58: work/travel (brake switch)

41: amount of operation of the acceleration pedal

(traveling pilot pressure)

55: amount of operation of the fuel lever (potentiometer)

42: pump pressure

56: high-horsepower driving mode switch

54: controlled rotational speed (potentiometer)

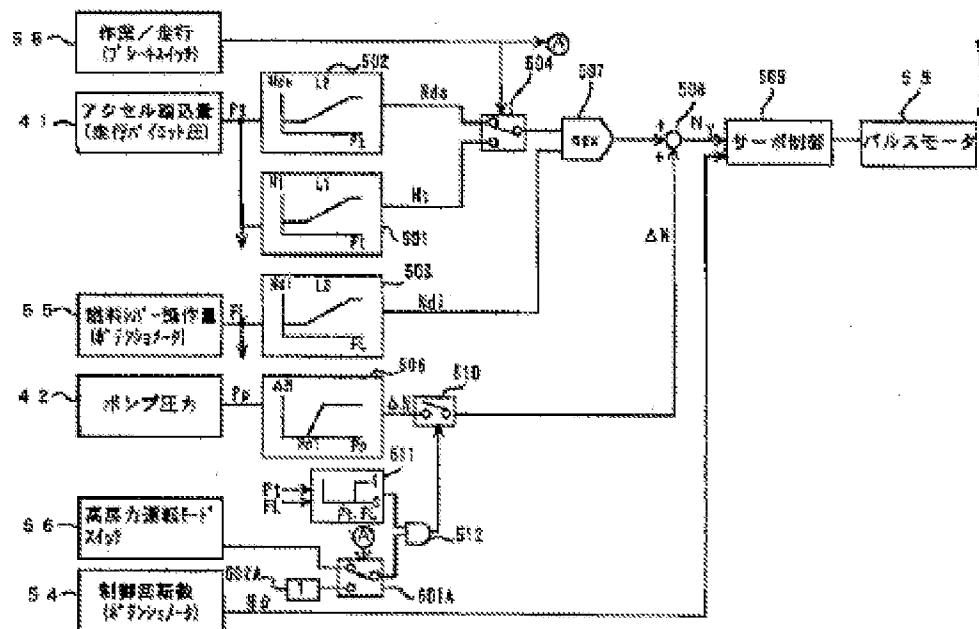
509: servo control

53: pulse motor

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[Figure 10]

【図10】



58: work/travel (brake switch)

41: amount of operation of the acceleration pedal
(traveling pilot pressure)

55: amount of operation of the fuel lever (potentiometer)

42: pump pressure

56: high-horsepower driving mode switch

54: controlled rotational speed (potentiometer)

509: servo control

53: pulse motor